Information for Parents, 2010

Department of Chemical & Biological Engineering

www.chbe.montana.edu

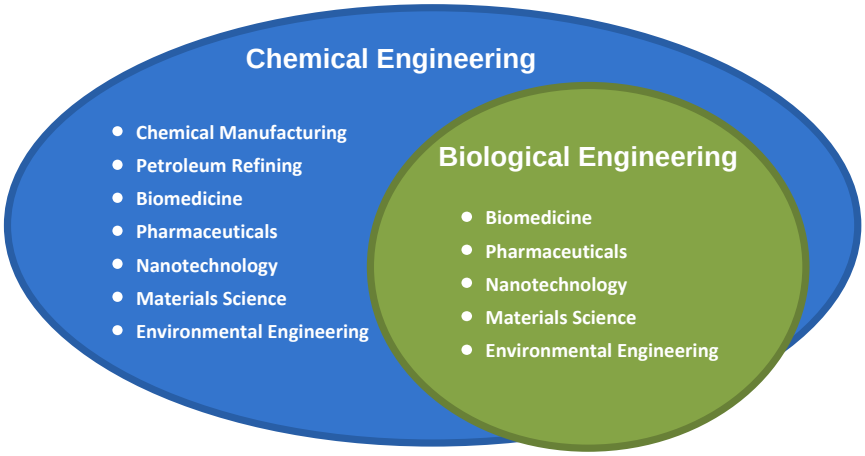
PARENT INFO

Welcome to Chemical and Biological Engineering!

Our goal is to prepare students to use their knowledge and skills to contribute to society and their profession. We offer undergraduate degrees in both chemical engineering and bioengineering.

The basis of both chemical and biological engineering is the useful transformation of matter from one form to another. That transformation can be brought about by direct chemical reactions, or chemical reactions mediated by living organisms.

Right now, chemical and biological engineers can work in many of the same areas. That may change as bioengineering develops as a profession, but bioengineers are likely to work closely with chemical engineers for the foreseeable future.



Both chemical and biological engineers are working with:

- Novel materials
- Food products
- Energy sources
- Pharmaceuticals

The list is expanding all the time - tomorrow's graduates may find careers in fields that do not even exist today as chemical and biological engineering research continually expands the opportunities.

If your student hasn't decided whether he or she wants a career in chemical or biological engineering, that's OK - the curricula for chemical engineering and bioengineering are identical for the first three semesters.

In the first three semesters the focus is on basic math and science courses, and both bioengineers and chemical engineers need chemistry, calculus, and physics. The curricula start diverging in the junior year when bioengineering majors take more bio-based science courses while chemical engineering majors take more engineering courses.

Technical Electives and Focus Areas

Both the chemical engineering curriculum and the bioengineering curriculum include 11 credits (about four courses) of technical electives. Students in either major can use these elective credits to focus on an area of interest.

Chemical Engineering Focus Areas:

- **Process and Product Engineering**
- **Materials Engineering**
- **Environmental Engineering**
- **Bioengineering**

Bioengineering Focus Areas:

- **Biomedical Engineering**
- **Environmental Engineering**
- **Bioprocess Engineering**
- **Food Engineering**

Technical elective courses are typically taken in the junior and senior years, so your student has some time to consider which area they might like to focus on.

Academic Advising

Students are encouraged to work closely with their academic advisers when selecting courses.

General Advising in Chemical and Biological Engineering

To make it easier for students to find an advisor, each CHBE student is assigned to two faculty members as academic advisors, according to the following schedule:

A-E	Jennifer Brown, Ross Carlson
F-L	Paul Gannon, Robin Gerlach
M-R	Jeff Heys, Brent Peyton
S-Z	Abbie Richards, Joe Seymour

Additionally, Ron Larsen (Department Head) serves as back-up advisers for all CHBE students.

Entering Freshmen

Ron Larsen serves as the advisor for entering freshmen during the summer and fall orientation sessions.

Transfer Students

Ron Larsen is the advisor for transfer students (Jeff Heys and Abbie Richards can also fill this role if needed.) Transfer students will need to meet with a transfer advisor until they get on track with the standard curriculum flowchart.

The evaluation of credits transferred from a previous institution takes place in two parts:

1. The University evaluates transfer courses for course equivalencies.
2. The Department then evaluates transfer credits for allowable course substitutions.

General Assistance

The academic advisors listed above will assist students in selecting courses. Once course selection is complete, the Department's Administrative Associate, Shelley Thomas, is available to assist students with registration questions and processes. Shelley's office is located in 306 Cobleigh Hall.

While we are limited in the amount of student information that we can give to parents, we will try to work with any parent that has questions or concerns.

Department Contact Information

- 306 Cobleigh Hall
- chbe@coe.montana.edu
- 406-994-2221

Department Head Contact Information

- Dr. Ron Larsen
- RonL@montana.edu
- 406-994-3790

Degree Requirements

Credit Requirements

The Department requires 128 credits for graduation, 43 of which must be in courses numbered 300 or higher.

Performance Requirements

Students starting their academic program in the fall of 2005 or later are required by Board of Regents policy to achieve a C- or better grade in each class used to satisfy the Bachelor of Science degree requirements.

Specific Course Requirements

Specific course requirements are listed in several places; however, the **MSU Undergraduate Catalog** is the official source of degree requirements. Degree requirements for the 2008-2010 Catalog are listed in this packet as well. Also, degree requirements are available as a flowchart (showing course prerequisites). These documents are available online at the following web addresses.

MSU CORE 2.0 Requirements

MSU's general education requirements are called "CORE" courses. In 2004 MSU adopted a new set of CORE requirements called CORE 2.0. These requirements, as they apply to CHBE majors, are summarized here.

CHBE majors must complete 12 credits of CORE 2.0 electives in the following areas:

- **IA** Inquiry Arts (3 cr)
- **IH** Inquiry Humanities (3 cr)
- **IS** Inquiry Social Sciences (3 cr)
- **D** Diversity (3 cr)

There are several other CORE 2.0 areas that are automatically met by courses required by the chemical and biological engineering curricula:

- **US** University Seminar (3 cr)
- **W** Writing (3 cr)
- **IN** Inquiry Natural Science
- **CS** Contemporary Issues in Science
- **Q** Quantitative Reasoning
- **R** Research and Creative Experience

Useful Web Sites

MSU Catalog
www.montana.edu/wwwcat

CHBE Homepage
www.chbe.montana.edu

CHBE Academic Information
www.chbe.montana.edu/Students/Academic Information.html

Approved CORE 2.0 Courses
www.montana.edu/core2/approved_courses.html

Required Courses

Chemical Engineering

Freshman Year	F	S
CHBE 100 Intro to Chem & Biol Engr	2	
CHBE 120 CHBE Computations		2
CHMY 141 General Chemistry I	4	
CHMY 143 General Chemistry II		4
M 171Q Calculus & Anl Geom I	4	
M 172Q Calculus & Anl Geom II		4
US or W CORE course	3	3
Univ. CORE Electives (IA, IH, IS OR D)	3	3
	16	**16**

Sophomore Year	F	S
CHBE 213 Materials Science		3
CHBE 215 Elementary Prin I	3	
CHBE 216 Elementary Prin II		3
CHBE 321 Fluid Mechanics Operations		3
CHMY 211 Organic Chemistry	5	
M 273Q Calc Funct Sev Varib	4	
M 274 Intro to Diff Equation		4
PHSX 220 Gen & Mod Phys I	4	
PHSX 222 Gen & Mod Phys II		4
	16	**17**

Junior Year	F	S
BCH 380 General Biochemistry	5	
CHBE 307 Chemical Engr Thermo I	3	
CHBE 322 Heat Transfer Operations	3	
CHBE 323 Mass Transfer Operations		3
CHBE 328 Chemical Reaction Eng		3
CHBE 438 Bioprocess Engineering		3
ENGR 310 Intro to Engr Design		3
I&ME 350 Applied Engr Data Analysis	2	
Univ. CORE Electives (IA, IH, IS OR D)	3	3
	16	**15**

Senior Year	F	S
CHBE 407 Chem Engr Thermo II	2	
CHBE 411R Design of Chem & Petr I	3	
CHBE 412R Design of Chem & Petr II		3
CHBE 424 Transport Analysis	3	
CHBE 442 CHBE Laboratory I	2	
CHBE 443 CHBE Laboratory II		2
CHBE 451 Process Dyn & Control		3
CHMY 373 Phys Chem Kinetics & Thermo		3
ENGR 499 Engr Prog Assmt		0
Technical Electives	6	5
	16	**16**

Bioengineering

Freshman Year	F	S
CHBE 100 Intro to Chem & Biol Engr	2	
CHBE 120 CHBE Computations		2
CHMY 141 General Chemistry I	4	
CHMY 143 General Chemistry II		4
M 171Q Calculus & Anl Geom I	4	
M 172Q Calculus & Anl Geom II		4
US or W CORE course	3	3
Univ. CORE Electives (IA, IH, IS OR D)	3	3
	16	**16**

Sophomore Year	F	S
CHBE 213 Materials Science		3
CHBE 215 Elementary Principles I	3	
CHBE 226 Principles of Bioengineering		3
CHBE 321 Fluid Mechanics Operations		3
CHMY 211 Elem Org Chem	5	
M 273Q Calc Func Sev Varib	4	
M 274 Intro to Diff Equation		4
PHSX 220 Gen & Mod Phys I	4	
PHSX 222 Gen & Mod Phys II		4
	16	**17**

Junior Year	F	S
BCH 380 General Biochemistry	5	
BIOB 375 Genetics		3
CHBE 324 Bioengineering Transport	3	
CHBE 439 Downstream Processing		3
CHBE 438 Bioprocess Engineering		3
ENGR 310 Introduction to Eng Design		3
I&ME 350 Applied Data Analysis	2	
BIOM 360 General Microbiology	5	
Univ. CORE Electives (IA, IH, IS OR D)		3
	15	**15**

Senior Year	F	S
CHBE 411R CHBE Design I	3	
CHBE 412R CHBE Design II		3
CHBE 461 Bioengineering Laboratory I	2	
CHBE 462 Bioengineering Laboratory II		2
Bioengineering Elective	3	6
Technical Elective	6	5
Univ. CORE Electives (IA, IH, IS OR D)	3	
ENGR 499 (FE Exam)		0
	17	**16**

Information from the US Bureau of Labor Statistics

www.bls.gov/oco/ocos027.htm

Chemical engineers apply the principles of chemistry to solve problems involving the production or use of chemicals and other products. They design equipment and processes for large-scale chemical manufacturing, plan and test methods of manufacturing products and treating byproducts, and supervise production. Chemical engineers also work in a variety of manufacturing industries other than chemical manufacturing, such as those producing energy, electronics, food, clothing, and paper. In addition, they work in healthcare, biotechnology, and business services. Chemical engineers apply principles of physics, mathematics, and mechanical and electrical engineering, as well as chemistry. Some may specialize in a particular chemical process, such as oxidation or polymerization. Others specialize in a particular field, such as nanomaterials, or in the development of specific products. They must be aware of all aspects of chemical manufacturing and how the manufacturing process affects the environment and the safety of workers and consumers.

Chemical engineers are expected to have an employment decline of 2 percent over the projections decade. Overall employment in the chemical manufacturing industry is expected to continue to decline, although chemical companies will continue to employ chemical engineers to research and develop new chemicals and more efficient processes to increase output of existing chemicals. However, there will be employment growth for chemical engineers in service-providing industries, such as professional, scientific, and technical services, particularly for research in energy and the developing fields of biotechnology and nanotechnology.

Environmental engineers are expected to have employment growth of 31 percent over the projections decade, much faster than the average for all occupations. More environmental engineers will be needed to help companies comply with environmental regulations and to develop methods of cleaning up environmental hazards. A shift in emphasis toward preventing problems rather than controlling those which already exist, as well as increasing public health concerns resulting from population growth, also are expected to spur demand for environmental engineers. Because of this employment growth, job opportunities should be favorable.

The field of bioengienering is less well definied. Here is what the Bureau of Labor Statistics says about biomedical engineers (a subspecialty within bioengineering):

Biomedical engineers develop devices and procedures that solve medical and health-related problems by combining their knowledge of biology and medicine with engineering principles and practices. Many do research, along with medical scientists, to develop and evaluate systems and products such as artificial organs, prostheses (artificial devices that replace missing body parts), instrumentation, medical information systems, and health management and care delivery systems. Biomedical engineers also may design devices used in various medical procedures, imaging systems such as magnetic resonance imaging (MRI), and devices for automating insulin injections or controlling body functions. Most engineers in this specialty need a sound background in another engineering specialty, such as mechanical or electronics engineering, in addition to specialized biomedical training. Some specialties within biomedical engineering are biomaterials, biomechanics, medical imaging, rehabilitation engineering, and orthopedic engineering.

Biomedical engineers are expected to have employment growth of 72 percent over the projections decade, much faster than the average for all occupations. The aging of the population and a growing focus on health issues will drive demand for better medical devices and equipment designed by biomedical engineers. Along with the demand for more sophisticated medical equipment and procedures, an increased concern for cost-effectiveness will boost demand for biomedical engineers, particularly in pharmaceutical manufacturing and related industries. Because of the growing interest in this field, the number of degrees granted in biomedical engineering has increased greatly. Many biomedical engineers, particularly those employed in research laboratories, need a graduate degree.

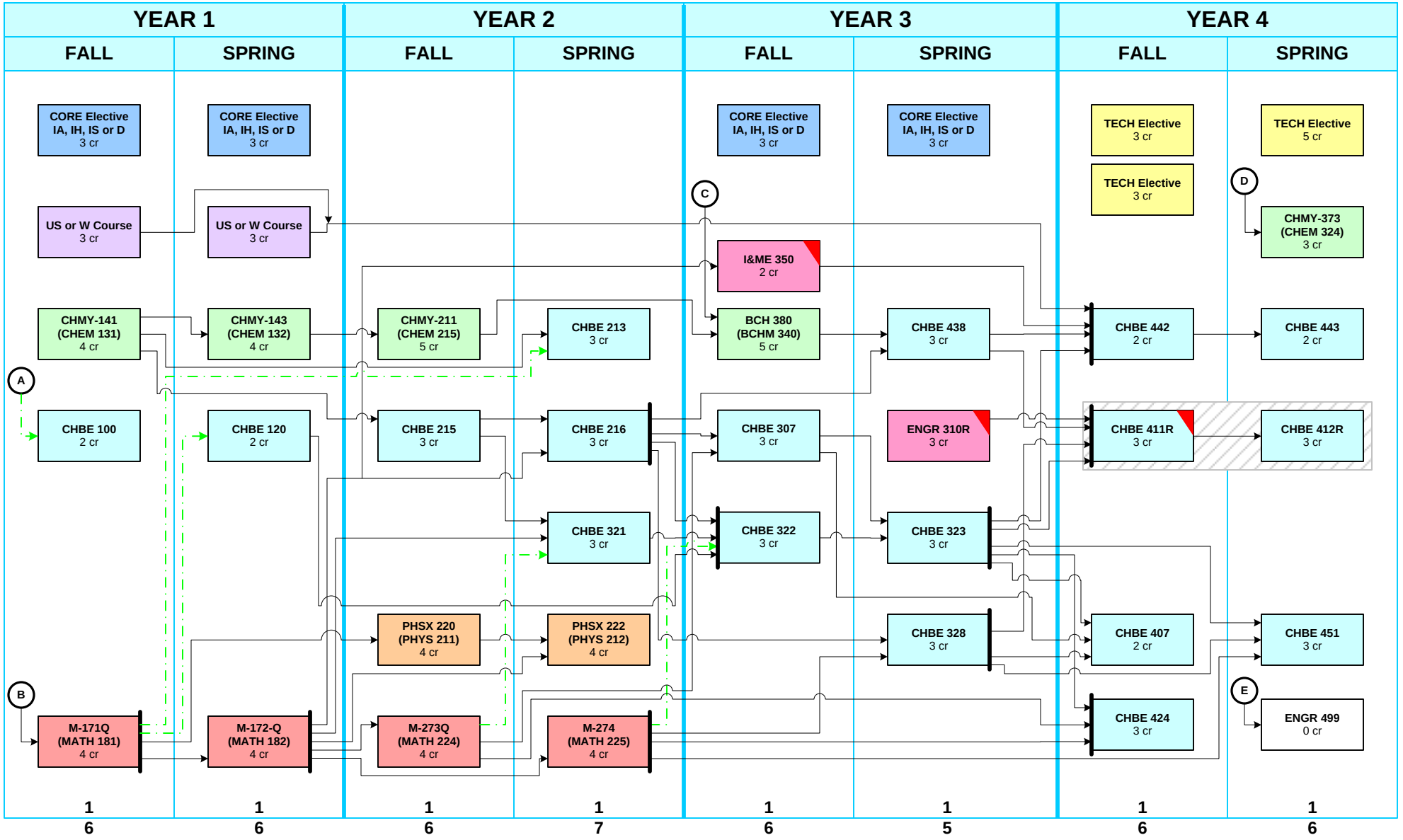
Curriculum *(2009 Data)*	**BS Starting**
Aerospace/aeronautical/astronautical	$56,311
Agricultural	$54,352
Bioengineering and biomedical	$54,158
Chemical	$64,902
Civil	$52,048
Computer	$61,738
Electrical/electronics and communications	$60,125
Industrial/manufacturing	$58,358
Materials	$57,349
Mechanical	$58,766
Mining and Mineral	$64,404
Nuclear	$61,610
Petroleum	$83,121
Aerospace/aeronautical/astronautical	$56,311
Agricultural	$54,352

Internship and Research Experiences

- Industrial internship opportunities are most often available after the junior year. Companies interview interested students through on-campus recruiting.
- Students may seek research internships after the sophomore year by searching for REU (Research Experiences for Undergraduates) Programs. The Department tries to help get the word out to sophomores about these programs by posting information on bulletin boards and via e-mail messages to students.
- About 25 to 30 undergraduates participate in research experiences as undergraduates each semester. There is no formal selection process; interested students simply contact researchers in the Department, or elsewhere on campus.

Chemical Engineering Prerequisite Flowchart

Catalog: 2008-2010 updated 2009



(A) M-151Q (MATH 160) Co-Req.

(B) Math Placement Exam

Pre-Requisite

Co-Requisite

(C) BIOL 102 pre-requisite, or ChBE Junior course standing (by agreement with Department)

The red corner indicates a change from the prior curriculum.

The hatched box indicates the senior design courses which must be taken in sequence.

(D) ChBE students who have taken an organic chemistry course may take CHMY-373 (CHEM 324) w/o CHMY-371 (CHEM 323) pre-requisite (by agreement with Chem Department). There is a pre-requisite of M-273Q (MATH 224).

CHMY-373 (CHEM 324) could be taken Spring of year 3.

Also, CHMY-371 (CHEM 323) may be substituted for CHMY-373 (CHEM 324).

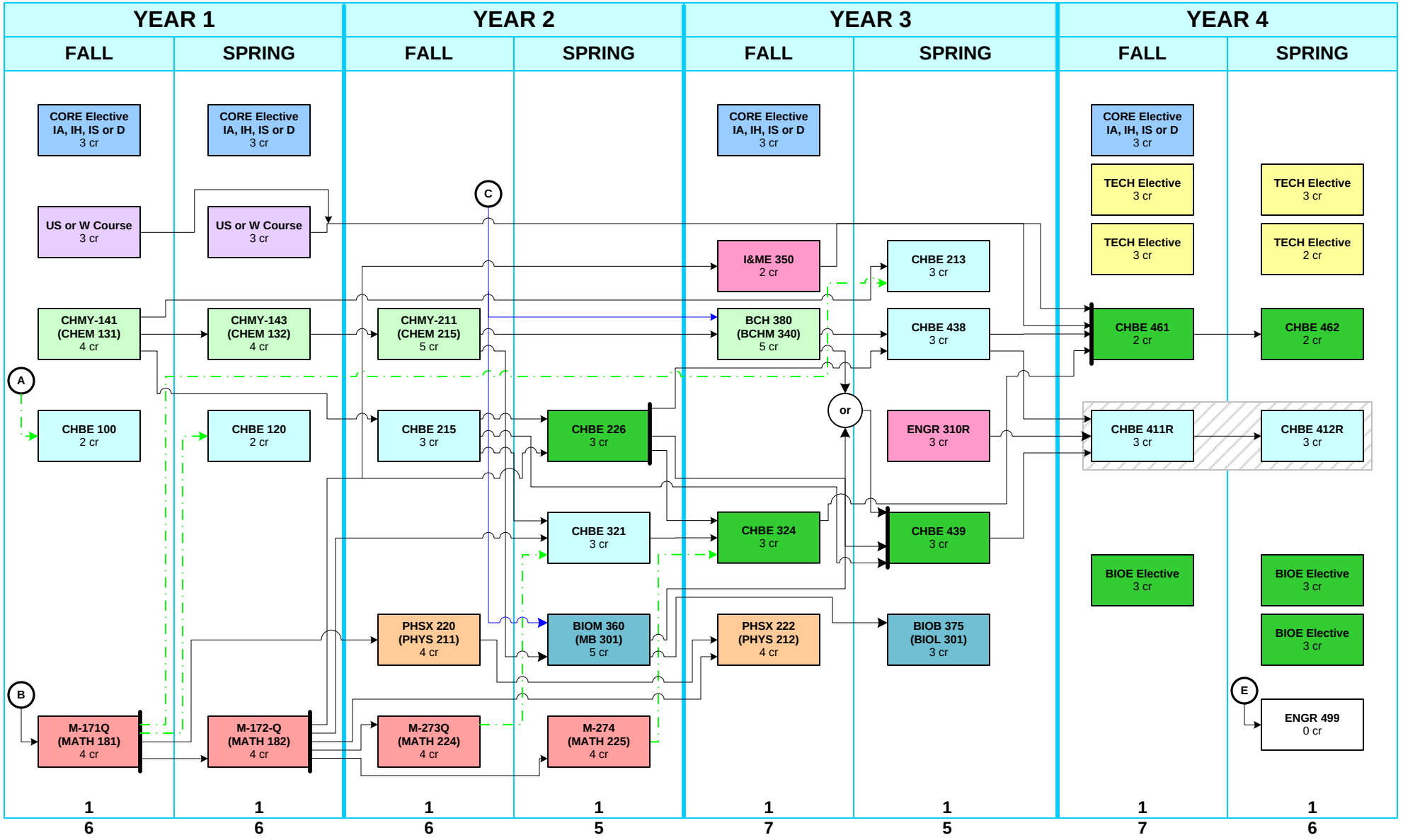
(E) Take the FE Exam your last semester before graduation

rev. 06/29/10, rwl – new course numbers

NOTE: This flowchart has been reviewed and updated, but there could still be errors. Please report any errors to Ron Larsen.

Bioengineering Prerequisite Flowchart

Catalog: 2008-2010 updated July 2009



A — M-151Q (MATH 160Q) Co-Req.

B — Math Placement Exam

Pre-Requisite

Co-Requisite

C — BIOL 102 pre-requisite, or ChBE Junior course standing (by agreement with Departments)

E — Take the FE Exam your last semester before graduation

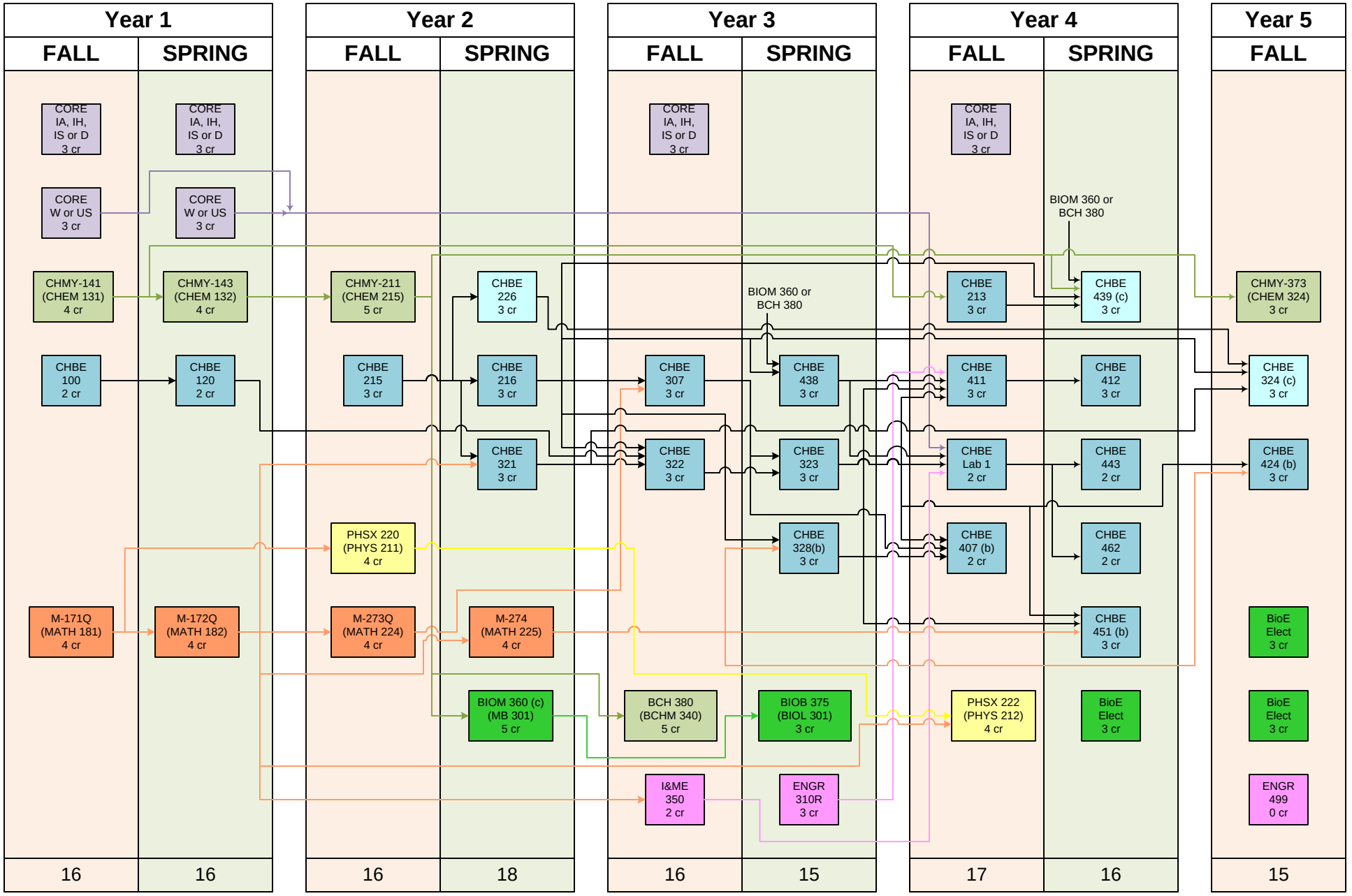
rev. 06/29/10, rwl – for new course numbers

NOTE: This flowchart has been reviewed and updated, but there could still be errors. Please report any errors to Ron Larsen.

The hatched box indicates the senior design courses which must be taken in sequence.

Dual Major CHE/BIOE Prerequisite Flowchart

Catalog: 2008-2010 updated July 2009



CHBE Lab 1 → CHBE 442 or CHBE 461

(b) – course used to meet BioE Tech Elective Reqt.
(c) – course used to meet CHE Tech Elective Reqt

Note: A dual-degree curriculum must meet graduation requirements for each degree. This flowsheet shows one way to do this, but this is not the only way to arrange these courses to meet the goal.

Revised 06/29/10 rwl – new course numbers